Claims:

1. A system for measuring strain experienced by a structure, said system comprising:

a) a sensor including:

i) a body having an electromagnetic resonator, said electromagnetic resonator adapted to produce a response signal in response to an interrogation signal, said body being coupled to said structure to allow said strain to alter the resonance properties of said electromagnetic resonator thereby altering said response signal; and,

ii) a coupler coupled to said body, said coupler adapted to transfer said interrogation signal into said electromagnetic resonator and transfer said response signal out of said electromagnetic resonator; and,

b) an interrogator being adapted to generate and transmit said interrogation signal to said sensor, said interrogator being further adapted to receive said response signal.

2. The system of claim 1, wherein said electromagnetic resonator is a dielectric resonator.

3. The system of claim 1, wherein said electromagnetic resonator is an electromagnetic cavity.

4. The system of claim 3, wherein said electromagnetic cavity is rectangular.

5. The system of claim 3, wherein said electromagnetic cavity is cubic.

6. The system of claim 3, wherein said electromagnetic cavity is cylindrical.

7. The system of claim 3, wherein said sensor further comprises a mechanical amplifier coupled to said electromagnetic cavity, said mechanical amplifier being adapted to amplify the magnitude of said strain on said electromagnetic cavity.

8. The system of claim 7, wherein said mechanical amplifier comprises a first member having a first region with a first length and a second member having a second region with a second length, said second region being coupled to said first region, wherein said first region is exposed to said strain and said second region is coupled to said electromagnetic cavity, wherein the magnitude of said strain experienced by said electromagnetic cavity is amplified by a factor equal to the ratio of said second length to said first length.

9. The system of claim 1, wherein said interrogator comprises:

a) an antenna for transmitting said interrogation signal and receiving said response signal; and,

b) a signal generator coupled to said antenna, said signal generator being adapted to generate said interrogation signal.

10. The system of claim 9, wherein said interrogator further comprises a detection module coupled to said antenna, said detection module being adapted to process said response signal to determine a value indicative of said strain.

11. The system of claim 10, wherein said interrogator further comprises:

a) an output module coupled to said control module, said output module being adapted to provide an output indicative of said strain; and,

b) a control module coupled to said signal generator, said detection module and said output module for controlling the operation thereof.

12. The system of claim 11, wherein said interrogator further comprises:

a) a memory module in communication with said signal generator, said detection module and said control module, said memory module being adapted to store information related to previously determined strains; and,

b) an input module in communication with said control module, said input module being adapted to allow a user to operate said interrogator.

13. The system of claim 10, wherein said interrogation signal is a continuous narrowband signal having a center frequency that is varied in a sweep range that includes a resonant frequency of said electromagnetic resonator and said detection module is adapted to detect a minimum in said response signal at a frequency within said sweep range, wherein said minimum occurs at said resonant frequency.

14. The system of claim 10, wherein said interrogation signal is a broadband signal having a frequency content that includes a resonant frequency of said electromagnetic resonator, and said detection module is adapted to detect a minimum in said response signal wherein said minimum occurs at said resonant frequency.

15. The system of claim 10, wherein said interrogation signal is a modulated narrowband signal having a center frequency that is varied in a sweep range that includes a resonant frequency of said electromagnetic resonator and said detection module is adapted to detect a peak in said response signal at a frequency within said sweep range, wherein said peak occurs at said resonant frequency.

16. The system of claim 10, wherein said interrogation signal is a modulated broadband signal having a frequency content that includes a resonant frequency of said electromagnetic resonator, and said detection module is adapted to detect a peak in said response signal wherein said peak occurs at said resonant frequency.

17. A sensor for measuring strain experienced by a structure, said sensor comprising:

a) a body having an electromagnetic resonator for producing a response signal in response to an interrogation signal, said body being coupled to said structure to allow said strain to alter the resonance properties of said electromagnetic resonator thereby altering said response signal; and,

b) a coupler coupled to said sensor, said coupler adapted to transfer said interrogation signal into said electromagnetic resonator and transfer said response signal out of said electromagnetic cavity.

18. The sensor of claim 17, wherein said electromagnetic resonator is a dielectric resonator.

19. The sensor of claim 17, wherein said electromagnetic resonator is an electromagnetic cavity.

20. The sensor of claim 19, wherein said electromagnetic cavity is rectangular.

21. The sensor of claim 19, wherein said electromagnetic cavity is cubic.

22. The sensor of claim 19, wherein said electromagnetic cavity is a cylindrical cavity.

23. The sensor of claim 19, wherein said sensor further comprises a mechanical amplifier coupled to said electromagnetic cavity, said mechanical amplifier being adapted to amplify the magnitude of said strain on said electromagnetic cavity.

24. The sensor of claim 23, wherein said mechanical amplifier comprises a first member having a first region with a first length and a second member having a second region with a second length, said second region being coupled to said first region, wherein said first region is exposed to said strain and said second region is coupled to said electromagnetic cavity,

wherein the magnitude of said strain experienced by said electromagnetic cavity is amplified by a factor equal to the ratio of said second length to said first length.

25. A method for measuring strain experienced by a structure, said method comprising:

a) coupling a sensor to the structure, the sensor having an electromagnetic resonator;

b) transferring through a coupler an interrogation signal into said electromagnetic resonator to evoke a response signal; and,

c) transferring through the same or a different coupler said response signal out of said electromagnetic resonator.

26. The method of claim 25, wherein said method further comprises processing said response signal to determine said strain.

27. The method of claim 25, wherein said electromagnetic resonator is an electromagnetic cavity and said method further comprises:

d) amplifying said strain in a mechanical fashion to amplify the magnitude of said strain experienced by said electromagnetic cavity.

28. The method of claim 25, wherein step b) comprises:

e) providing said interrogation signal as a continuous narrowband signal; and,

f) sweeping the center frequency of said narrowband signal in a sweep range that includes a resonant frequency of said electromagnetic resonator.

29. The method of claim 28, wherein step c) comprises processing said response signal to detect a minimum at a frequency within said sweep range indicative of the resonant frequency of said electromagnetic resonator.

30. The method of claim 25, wherein step b) comprises:

a) providing said response signal as a continuous broadband signal having a frequency content that includes a resonant frequency of said electromagnetic resonator.

31. The method of claim 30, wherein step c) comprises processing said response signal to detect a notch at a frequency indicative of the resonant frequency of said electromagnetic resonator.

32. The method of claim 25, wherein step b) comprises:

e) modulating said interrogation signal to provide an intermittent narrowband signal; and,

f) sweeping the frequency of said intermittent narrowband signal in a sweep range that includes a resonant frequency of said electromagnetic resonator.

33. The method of claim 32, wherein step c) comprises processing said response signal to detect a peak at a frequency within said sweep range indicative of the resonant frequency of said electromagnetic resonator.

34. The method of claim 25, wherein step b) comprises:

a) modulating said interrogation signal to provide an intermittent broadband signal having a frequency content that includes a resonant frequency of said electromagnetic resonator.

35. The method of claim 34, wherein step c) comprises processing said response signal to detect a peak at a frequency indicative of the resonant frequency of said electromagnetic resonator.